

# Viewpoint: From MOOCs to SPOCs

[Draft version. Submitted as an opinion piece to *Communications of the ACM*, [cacm.acm.org](http://cacm.acm.org). Version: 4/29/2013]

As the media's infatuation with MOOCs continues unabated, some academics seem to be succumbing to the hand-wringing about whether MOOCs will destroy higher education as we know it (*Will MOOCs Destroy Academia?*, Moshe Vardi, CACM 55(11), Nov. 2012). Is it a bad thing that we "have let the genie out of the bottle", as Dr. Vardi suggests? I argue that a close, systematic, and sustained look at how MOOCs are *actually* being used should persuade the careful observer that taseful use of MOOC technology can *strengthen* academia.

Note that I don't say "MOOCs *will* strengthen academia". They certainly *can*, but whether they *do* depends on how they are received and used by academics. Full disclosure: besides being a MOOC instructor myself, I'm the newly appointed co-director of Berkeley's online education programs, which have recently been extended to include MOOCs. But I'm not cheering for MOOCs because I have this position; rather, I agreed to take the position because I'm excited about the possibilities of MOOCs and other online education. In particular, if MOOCs are used as a supplement to classroom teaching rather than being viewed a replacement for it, they can increase instructor leverage, student throughput, student mastery, and student engagement. I call this model the SPOC - Small Private Online Course.

To set the context for this discussion, let me use the SPOC idea to offer counterexamples to some "MOOC myths" in recent media coverage. While most myths are based on a kernel of truth and may be true of at least some MOOCs, they are just as often *untrue* and it's a disservice to interested readers to present them as foregone conclusions or *faits accomplis*.

## Myth: Universities will use MOOCs to lower costs by firing faculty and TAs, thus sacrificing educational quality.

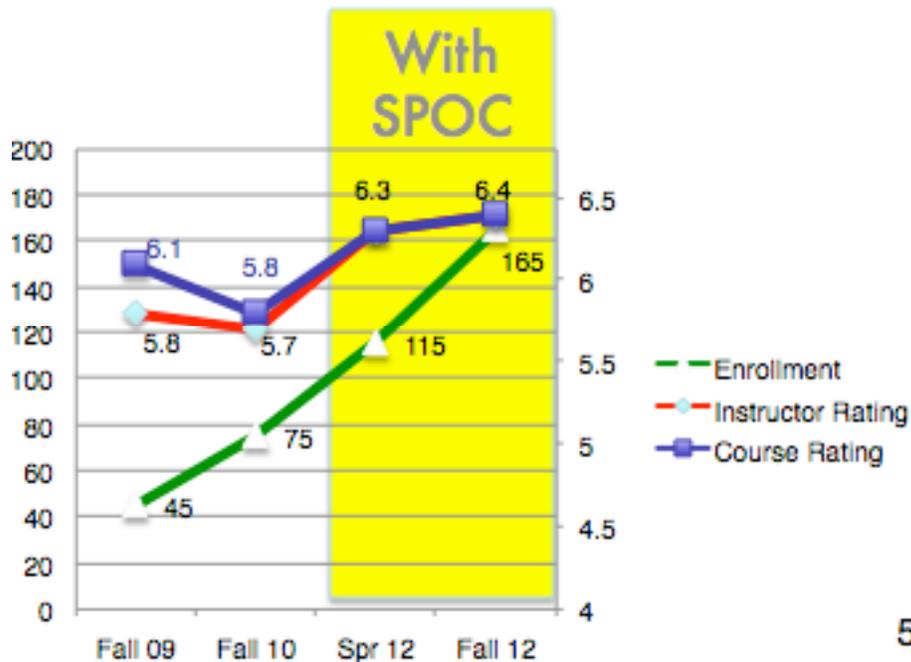
If universities were looking to replace existing courses partially or entirely with MOOCs, this might be true. However, many universities are successfully using MOOC technology quite differently. For example, in a recent pilot program at San José State University in California, students in an analog circuits course used MIT-authored MOOC lectures and homework assignments created by Prof. Anant Agarwal<sup>1</sup>. The students' in-classroom time was spent working on lab and design problems with local faculty and TAs. The

---

<sup>1</sup> *California to give web courses a big trial*. The New York Times, January 15, 2013. [http://www.nytimes.com/2013/01/15/technology/california-to-give-web-courses-a-big-trial.html?\\_r=0](http://www.nytimes.com/2013/01/15/technology/california-to-give-web-courses-a-big-trial.html?_r=0)

students in this SPOC (Small, Private Online Course) scored 5 percentage points higher on the first exam and 10 points on the second exam than the previous cohort that had used the traditional material. Even more strikingly, the proportion of students receiving credit for the course (“C” or better grade) increased from 59% to 91%. So educational quality arguably *increased*, and costs were lowered by helping students graduate more quickly, rather than by firing people. Productivity was enhanced because the on-campus instructors shifted their time from what they perceived as a lower-value activity—creating and delivering lectures on content that hasn't changed much—to the higher-value activity of working directly with students on the material. Several of my colleagues in the California State University system and the community college system have expressed similar enthusiasm. This model takes advantage of important MOOC features, including access to high-quality materials and rapid feedback to students via autograding, to maximize the leverage of the scarce resource—instructor time.

Closer to home, my colleague David Patterson and I created a MOOC based on our upper division software engineering course at Berkeley, and subsequently used the MOOC material as a SPOC in our on-campus course. A key feature of this course is four different autograders for different types of software engineering assignments. These autograders were created by investing several hundred engineer-hours in repurposing tools used by professional programmers. Students not only get finer-grained feedback than they'd get from human TAs, who can spend at most a few minutes per assignment, but now have the opportunity to resubmit homeworks to improve on their previous score and increase mastery. The autograders give feedback on coding style and test completeness as well as simply code correctness. As the figure below shows, the SPOC model has allowed us to increase the enrollment of the course nearly fourfold while yielding *higher* instructor and course ratings (in fact, the highest in the course's 20-year history) even though the fundamental material covered has changed very little. (The MOOC version of the course is available as “BerkeleyX CS169.1x” on edx.org.)



5

**Draft figure—I can provide raw data and/or a final figure for final MS:** Course enrollment and instructor & course ratings (given anonymously by enrolled students, solicited by Eta Kappa Nu Engineering Honor Society each semester within Berkeley Engineering) of CS 169 Software Engineering with and without SPOC supplement.

**Myth: MOOCs will fail because many aspects of traditional classes, such as small-group discussions and face-to-face time with instructors, do not work in the MOOC format.**

This assertion is true, but it implicitly and incorrectly assumes that replicating the classroom experience is the proper goal for an online course. *If* that were an appropriate goal, then MOOCs would indeed fail to meet it. However, as educators, a better question for us to ask is this: What *can* be delivered effectively through this medium in a way that helps our on-campus students, and has the valuable side effect of helping the hundreds of thousands who won't have the privilege of attending our universities in person? (Indeed, many of our MOOC students reported that our course was better than anything available at the brick-and-mortar campuses to which they had access.) Using MOOC materials in a SPOC format is one way that MOOCs can indeed be successful in helping to answer this broader question.

For example, rather than asking whether automatic graders (which, by the way, have been around since at least 1960<sup>2</sup>) can *replace* individual instructor attention, we can ask: When can they relieve teaching staff of drudgery, allowing scarce instructor time to focus on higher-value interactions such as tutoring and design reviews? Rather than worrying whether MOOC-based social networking will *replace* face-to-face peer interactions, we can ask and experimentally answer: Under what conditions and with what types of material do online communities help foster learning, and how can social networking technology help foster both online and in-person community building? And learning activities that don't appear to be “MOOCable”—discussion-based learning, open-ended design projects, and so on—can just be omitted from the MOOC but covered in the classroom setting, as we've done in our software engineering course, whose MOOC version lacks the on-campus course's open-ended design project. Indeed, at universities on the quarter system, it's common to offer a two-quarter sequence in which the first quarter focuses on well-circumscribed assignments and the second quarter focuses on a design project, since a single quarter can't cover both. The first course clearly has value despite lacking a design project, and could be offered as either a MOOC or a SPOC. By analogy, MOOCs that don't offer “the same” experience as a complete residential course also have value, and our job as educators is to make judgments about where that value lies and how to combine it with the other education modalities we offer our students.

### **Myth: MOOCs distract faculty who should be focusing on improving their on-campus pedagogy.**

Even if using a SPOC in the classroom, faculty can still leverage the scale of an (open) MOOC to *enhance* their classroom teaching. In fact, the large enrollments of MOOCs offer us new and unprecedented opportunities to improve our on-campus courses using inferential statistics techniques that just don't work at smaller scales, and so were previously available only to large-enrollment “high stakes” exams such as the GRE or SAT<sup>4</sup>. For example, exploratory factor analysis<sup>5</sup> lets us identify questions that test comparable concepts, giving instructors a way to vary exam content. Item response theory<sup>6</sup> allows us to discover which questions are more difficult (in the statistical sense that higher-performing students are more likely to get them right). A/B testing gives us a controlled way to evaluate which approaches have better effects on learning outcomes, just as high-volume e-commerce sites evaluate which user experience results in more

---

<sup>2</sup> Hollingsworth, J. Automatic graders for programming classes. CACM 3(10), Oct. 1960

<sup>4</sup> The Graduate Record Exam (GRE) and Scholastic Aptitude Test (SAT) are standardized tests that are part of most students' applications to American graduate and undergraduate programs respectively.

<sup>5</sup> Lawley, D., Estimation of factor loadings by the method of maximum likelihood. Proc. Royal Soc. Edinburgh, 60A, 1940.

<sup>6</sup> Lord, F.M. Applications of item response theory to practical testing problems. Mahwah, NJ: Erlbaum, 1980.

purchases. None of these techniques works on classroom-sized cohorts (say, 200 or fewer students), but we are applying all of them to our current MOOC. Indeed, not all instructors will be eager to receive the avalanche of MOOC data telling us what's not working in our courses and how we can improve them, but our sense at Berkeley is that MOOCs may well raise the bar for acceptable teaching on campus, as well as improve the recognition of good teaching, perhaps bringing the era recycled PowerPoint slides finally to a close.

In addition, in each of four offerings of our software engineering MOOC totalling over 100,000 enrollees, about 8%, or nearly 32,000 total, identified themselves as *instructors*, suggesting that MOOCs may be even more effective than traditional textbooks at “teaching the teachers” and getting innovative new pedagogy out to a large audience. In fact, our faculty colleagues who are classroom-testing our unconventional new textbook *Engineering Long-Lasting Software: An Agile Approach Using SaaS & Cloud Computing* are all doing so in conjunction with our MOOC (EdX CS 169.1x), so that they can take advantage of the autograders, screencasts and other materials.

### **Myth: MOOCs will reduce diversity in instructors and teaching approaches because economics will favor a “winner take all” scenario in which one specific MOOC will dominate each course.**

In her widely-cited *Tools For Teaching*<sup>7</sup>, Davis recommends that lecture styles and teaching strategies should vary depending on the nature of the material and the target audience of students. Even if one or a few MOOCs dominates a particular course, thereby replacing various instructors’ different teaching approaches with the MOOC instructor’s single approach, we can, like Prof. Doug Fisher and others<sup>8</sup>, selectively adapt the content for SPOC use in our own on-campus courses, as we have long done with textbooks. Indeed, one could have raised a similar complaint about the printing press: it homogenized book production and eliminated the social rituals associated with acquiring books. Yet it also created vastly more readers, gave voices to authors who would never have had them, and introduced new tools that teachers could use in conjunction with their lecturing. In a similar way, MOOCs won't replace high-quality face-to-face instruction, but we can reach many more learners, leading to a net social and economic benefit, and we can give many great teachers a more prominent voice than they have had since Socrates.

### **Conclusion**

MOOCs represent a new technology opportunity whose potential pedagogical impact needs to be researched. I have argued that MOOCs themselves can yield valuable

---

<sup>7</sup> Davis, Barbara Gross. *Tools for teaching*. Jossey-Bass, 2009.

<sup>8</sup> Fisher, Doug. Warming up to MOOCs. Chronicle of Higher Education, Nov. 6, 2012. <http://chronicle.com/blogs/profhacker/warming-up-to-moocs/44022>

information because of their scale, and that MOOC materials can be used in a blended setting called SPOC or Small Private Online Course to supplement the classroom experience. Both MOOCs and SPOCs are two design points in a wider space in which experiments are possible. To be sure, many bad experiments will be tried—some are probably already underway—and many worthy experiments will fail or have a different outcome than desired. But if failed experiments were an obstacle to doing world-changing research, we academics would probably choose a different job.